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The object of this discussion is to call attention to the factors considered in appraising stumpage, rather than to give a detailed plan of procedure. Few areas present similar conditions, and consequently new problems are always at hand.

Efficiency in appraising stumpage values comes largely through experience in the work, and set rules and regulations will serve merely as a guide. To the experienced man, no doubt, the contents of this paper will present few new facts, but to the uninitiated, it will give an idea of the various matters included in a field study of this character.

All of the factors that must be considered will be taken up in the order in which they arise as the log proceeds from the timber to the cars. When all woods and sawmill work become standardized, set rules can be laid down for many of the logging activities, but at present the methods vary greatly with the individual operations.

Preliminary Work—Surveying and Estimating

The first thing to be done on a prospective timber sale area is to determine the actual amount of land covered with timber and what part of the area is merchantable. In addition, it is absolutely necessary that a very accurate estimate of the merchantable timber be made and the percentage for cutting determined. Inaccuracies in this work will directly affect the stumpage price, in as much as the final costs are all reduced to a basis of one thousand feet board measure, the amount being dependent upon the density of the stand as well as upon other factors.

While the tract is being surveyed to secure this data, the exterior boundaries should be blazed and the corners well marked by self explanatory stakes. This helps to keep the

timber sale area under better control while the work is in progress.

The estimate of the standing timber must be obtained by using some method of reconnaissance which will be both intensive and accurate. Different species and different stands have their best methods, and that one which is most applicable should be used. While making the survey, full notes on all points that might be of use should be made. These should include the location of possible mill sites, swamps, down timber, and, in fact, anything of importance that a topographical legend will not show. The survey will not be complete until enough data is secured to allow the making of a map that will show everything pertinent to the logging operations. This map should include the location of all areas that require peculiar methods of logging. For instance, there might be a high mesa which should be logged from a camp on the mesa. It may be cheaper to "chute" the logs than to build roads to the top, or the mesa may be a "dry" one, necessitating the establishment of a "tank" camp or the resorting to the use of snow for water for stock and domestic consumption. All such conditions should be shown and in such a way that anyone can readily realize the problems involved. Then intelligently planned operations will be possible.

Construction Work.

Of equal importance to these activities is the choice of the proper sized mill for the operation. This will depend upon the market for the product and the woods investment. Knowing this latter, the annual cut and the date of the final cut can be set. These figures are further necessary for figuring depreciation and interest charges. The character of the timber and method of logging having been determined, the amount of stock and the number of men needed to log to the mill and to operate the mill itself can be determined. In an operation involving the use of a railroad there may be a choice between two methods of logging. If the area is level, it may be possible to run a number of spur tracks into the woods and use steam power for handling the logs. In such a case a smaller outlay for animal power will be necessary than if the topography is so rough as to necessitate wagon or other methods of hauling. If

the area comprises much swampy, brushy or dangerous ground, or if many large logs will be handled, the use of oxen may be more economical. There may be use for both oxen and horses, and the number of each will be in proportion to the amount of each kind of logging that will be encountered. Horses are preferred for ground that is easy to work on.

It is usually necessary to purchase live stock at some live stock market, and from this source data for fixing this cost can be secured. In figuring depreciation charges, it is considered that horses will last about ten years and oxen about eight.

For hauling in the woods, either the use of trucks or of "two wheelers" will be possible. For long hauls and rougher ground the former should be used; for short hauls of any kind, the latter are to be preferred.

A rough or preliminary survey for the railroad must be made and the location of the mill and all camps must be indicated. The cost per mile for the railroad and its total length in terms of main line and spur track will be computed from this survey. It is to be remembered in this connection that the cost for spur line track is not as great as for main line and that too much main line should not be anticipated. The character of the ground, the amount of rock work, bridging, cutting and filling are essential points for consideration. Also, the distance from available tie timber influences the cost of the railroad. As much of the railroad as possible should be constructed after the mill is running, in order that ties cut at the mill may be used in the construction work. Second hand steel can usually be rented from railroads for a specified sum per year per track mile, and calculations will show whether or not this rental will amount to more than the purchase price of new steel. When steel is purchased, the interest on its cost as well as the interest on the cost of spikes, bolts, plates, etc., must be considered.

The preliminary survey will show whether or not it will be possible to lay spur tracks into the woods sufficiently close to permit the use of steam skidders and car camps, or whether stationery camps should be constructed. In the latter event, wagon hauling from the woods to the track would usually be necessary. Allowance must be made for switches which will

be required on hills over which the loads must be "doubled up", and also at most of the skidway sites.

The location and probable cost of all of the woods roads must be carefully considered and can be determined only by actually going over every foot of the ground, because the cost of construction over various kinds of ground differs so materially. Rock work, soft or wet ground, bridges, cuts and fills must all be figured separately. Some areas are distinctly winter-logging propositions, requiring the construction and maintenance of snow roads for hauling. This method is especially applicable in the case of long hauls where big loads are possible, due to the lay of the ground. Some preliminary grading is usually necessary for snow roads. In any case, the purchaser of the timber should be allowed an adequate amount for the construction of *good* logging roads, but care must be taken to distinguish between the roads over which much must be hauled and those over which little will be hauled.

The location and cost of constructing skidways along the railroad should be considered along with the cost of roads. Here again, the expense of making *good* skidways should be allowed, since *cheap* ones always increase the cost of handling the logs.

The size of camps depends upon the number of men to be housed. Sometimes the operators charge the men house rent, and in such a case there should be no charge made against the logs for that part of the camp. The size of barns depends upon the amount of stock to be housed, which in turn, depends upon the size and duration of the operation; so that the amount of timber that will be handled from a camp decides the cost chargeable against each thousand feet for this item. Three kinds of camps are possible: tent camps, car camps and board camps, or combinations of the three. The amount to charge against the logs is the actual amount that the company will be out for the buildings at the end of the operation. Should there be an opportunity to sell any of the old lumber used in the buildings when the camp is discontinued, then the amount realized should be deducted from the cost of buildings before this is charged against the logs.

The shacks are sometimes placed on skids, loaded on log cars and moved to a new site.

Woods Work

The charge for cutting should include the cost of felling, sawing into logs, and limbing. It is rather difficult to set the proper price for this operation and the closer the woods are studied the more accurate this charge will be. The distance from camp, the degree of slope and character of the ground, the size of the timber, its quality as regards freedom from limbs, the size of the limbs, the amount and density of the brush in the woods, the ability of the saw filer, the depth of the snow, and the frequency of the loading places, are all factors which must be given consideration. Of these, the last, together with the size of the timber and the character of the land, are the main factors to consider.

The cost of skidding will depend largely upon the ability of the woods foremen. Where the country is rolling or level, short skidding distances are possible, and a lower charge for this operation results. In dense brush, deep snow, or swampy ground, or in handling large logs, oxen can be used with good results, while in open, level country, horses should always be used.

The cost of brush disposal naturally depends upon the size and number of limbs and the method of disposal; i. e., whether it is to be scattered or whether it is to be piled and burned. In certain localities, the old idea of piling and burning is losing favor, and the method of scattering the brush without burning is thought to be the cheapest and most practical as well as best silvicultural method. If the operator has a market for hewn ties and mine timbers that can be made from the tops, then the cost of brush disposal will be lessened because there will be less of the tops to lop. If there are any special phases of brush disposal required, such as throwing brush into old skid trails and roads or into washes to prevent erosion, then the operator should be allowed the additional expense. On National Forest lands, a good method for the operator is to contract for this work at a specified price per thousand feet, Government scale. By doing this he saves the cost of supervision, since it is the duty of the Forest officer supervising the sale to pass upon the quality of the work.

The cost of hauling the logs from the woods to the skidways is dependent upon several things, first of which is the size of

horses to use. This is a very important matter. In a level country heavy horses are desirable, say 1600 to 1800 pound wheelers and 1400 pound leaders. In a rough country lighter horses must be used since the heavy animals can not stand the hills. There are also places where oxen can be used to advantage, and in figuring the charge for feed for them, the amount of forage in the woods that can be utilized as feed should be considered. A good way to use oxen is to assign them to the hard logging propositions and make them both skid and haul their own loads.

The length of the haul, measured in terms of number of trips per day, is the second important factor influencing the cost of hauling. If the roads slope all of the way to the camps or skidways, then big loads are possible, but if a hill is encountered, the size of the load must be reduced unless it is planned to "double up" with an extra team where the grade is steep. Large loads mean less trips per day, and hence shorter total length of haul in the number of trips per day. The amount of sleigh logging that will be possible will have a similar influence and must be considered, keeping in mind the fact that usually a fifty per cent larger load can be hauled on a sleigh than on a wagon.

The cost of blacksmtihing, horse feed, and wages for feeding should be pro rated to the different operations concerned, according to the number of horses used on each.

The upkeep of the woods roads is an item to be distinguished from the cost of construction of the roads. Careful observations must be made before the appraiser is enabled to make an accurate estimate of the cost of upkeep. He must make these observations while the ground is bare of snow because the wearing quality of the dirt has a great effect on cost of upkeep. Where corduroys are constructed considerable repair work will have to be done after they have been in use for a year. Bridge floorings on roads where much hauling is done will also have to be renewed often. On woods roads over which 30 to 40 thousand feet b. m. are hauled daily, it will require the services of laborers continually to keep the roads in repair, the number depending on the length of the road. Chuck holes and repairs on corduroys and bridges will be the

main worries. Cull lumber should always be figured for repair work.

Railroading

For the loading work, a choice will be possible between steam loading and the cross haul method, using horses. The type chosen invariably depends upon the size of the operation. Five men and two horses can load 70 to 80 thousand feet b. m. per day and will do the work cheaper than a steam loader, if the loading crew does nothing but load. The latter will do it quicker, and, if they can also do some skidding, it is generally preferable to the other method. If the spur tracks run right into all parts of the woods, then the steam loader will both skid and load, and the old cross haul method should be abandoned. In deciding which to use, the cost of loading by each method should be figured. The expense chargeable against the steam loader will be the wages of the crew, cost of fuel, oil, upkeep, and depreciation, and interest on the investment.

The cost of the railroad haul is best determined by comparison. The length of the haul and the grade of the road, together with the number of cars handled each day, are some of the factors that must be known, as is also the cost of coal, or of oil, if oil burners are used. The amount of fuel required and the cost of train crews can be found by comparison with a similar run. If the log train runs over the tracks of a common carrier on any portion of the run, a conductor and two brakemen are necessary, but over logging railroad track, a conductor and one brakeman are usually enough. The train crew must be allowed time for switching, the amount depending upon the manner in which the yards are laid out. This charge is usually about ten per cent of the total railroad operation charge. The cost of unloading the cars and getting the logs into the pond is usually only three or four cents, and so is unimportant.

The cost of upkeep of the right of way and rolling stock is considerable. The cost for tie renewals is figured by considering the length of life in years for the ties and then figuring an annual renewal of one in that number. For example, if yellow pine ties are used, there would be an annual renewal of one in six, since six years is the average life of a western yellow

pine tie. Cull ties from the mill should be used for renewals, and the rate of replacement in this case should be made one in four rather than one in six. When the steel is rented, the railroad supplying it furnishes the rails for replacement. Little, if any, ballasting need usually be counted on.

The rolling stock is constantly in need of repair, and the cost of this depends much upon the original quality. Upkeep on second hand stock will be more than on new stock, and whether new or second hand stock is to be used will be a matter of personal judgment backed up by the advice of a mechanic who is familiar with the rolling stock that will be used. The log cars will have a longer life if they are of the modern class, like a "Russell", than they will if they are of the old fashioned, all wood type.

Milling

The efficiency of the mill will depend largely upon the ability of the sawyer and the other high salaried men in the mill, and therefore, good salaries should be allowed in making stumpage appraisals.

Much depends upon the quality of the mill-site. The appraiser should take into consideration the adaptability of the mill site and yards for efficient and economical handling of the logs and sawed products. There are many chances for this factor to vary in a mountainous country.

It must be assumed that the best and most economical methods will be used, and then there must be taken into consideration any factors that will cause a deviation, and allowances made for them. It requires much experience to fit a man for accurate appraisal of the milling end of a lumbering operation.

The charge for milling should include the cost of scaling, sawing, sorting or grading, transportation within the mill and yards, edging, planing, drying, piling, and loading on the cars ready for market. There is also a charge for pond expense, which includes moving the logs in the pond and cleaning the pond at intervals.

The operators should also be allowed something for installing and maintaining a fire protection system in the yards and mill.

Overhead Expense

The cost of supervision should include only the salary and expenses of a general manager. The salaries of all of the foremen are charged directly to the part of the operation that they are given supervision of.

The cost of bookkeeping will depend largely upon the capacity of the mill, the size of the commissary, and the number of camps in the woods.

The charge of selling depends upon the market. If inferior species are cut and they are competing with a better species, the marketing item will be high. If a retail yard is maintained in some city away from the mill, the cost of selling will be higher than if the product is sold only by salesmen.

The charge for insurance is always high because saw mills and lumber yards are always considered as a big risk. The best way to get at this cost is to secure rates from a local agent. The charge for taxes will also be secured from local sources.

Depreciation is the loss in value of the plant and equipment that is not made good by upkeep and includes all equipment in the woods. As stated in a Forest Service circular letter: "It is usually met by charging against annual operating costs a certain portion of the investment; that is, by gradual reductions charged against costs of operations, the investment is kept at its actual value, and the depreciation is thereby accounted for in the costs of production and net earnings".

If, for instance, the operations will continue for five years, and there will be $20,000 tied up, and the outfit will deteriorate at the rate of one-fifth of itself each year, the method of fixing the depreciation and interest on investment is according to the following table:

Period of Operation	Investment on Which Interest Must be Paid	Actual Interest at 6 Percent	Depreciation at End of Each Year
First year.....	$20,000	$1,200	$ 4,000
Second year.....	16,000	960	8,000
Third year.....	12,000	720	12,000
Fourth year.....	8,000	480	16,000
Fifth year.....	4,000	240	20,000

The charge for obsolescence is a rather difficult one to determine. It affects that part of the equipment that is the most

intricate. Usually it is safe to say that after a period of ten years enough improvements will have been made upon such machinery so that the substitution of the improved piece will be profitable.

Equally as important as the knowledge of the cost of operation is the knowledge of the selling price of the product. When a sale is being made to a new operator, the only way to get this is to find out what prices are obtained by the concerns with which the buyer is going to compete. If the purchaser is already operating, his past prices should be used, subject to any changes in the market. It is always well to cooperate with the purchaser in determining this selling price. The value of the mill run, that is, the figure obtained by dividing the total amount obtained for the entire product of the mill by the number of thousand feet this product represents, gives the selling price. The value of all by-products, such as hewn ties and mine timbers made from the tops, must be included here.

Unless it is possible to secure very good figures on overrun from some mill that is already operating in timber similar to that being sold, this factor should be given very careful study. When reliable data are at hand, the costs of operation from the stump to the mill should be based on log scale, but the costs after milling should be based on the actual amount, board measure, sawed from the logs.

Determination of Stumpage Price

The Forest Service now uses a formula for fixing the stumpage price, after the cost of operation and the selling price are known. Its principle in brief is that the difference between the selling price and the cost of production contains both the stumpage price and the operator's profit. A statement of the formula is:

$$(S \div P) - O = X,$$

in which S is the selling price, P is 1+ the per cent of profit, O the cost of operation, and X the stumpage price.

Assume an operating cost of $12, an average selling price of $17, and a per cent of profit of 20. By substituting these values in the formula, a stumpage price of $2.17 is obtained as follows:

$$(\$17 \div \$1.20) - \$12 = \$2.17$$

The per cent of profit should vary with the risk involved and the magnitude of the operation.

Below is an outline of the factors considered above:

I. Preliminary Work.
   A. Surveying.
      1. Find amount of timber land.
      2. Find amount of non-timber land.
   B. Estimate.
      1. Total stand.
      2. Amount to be cut.
   C. Map.
      1. Should show everything pertinent to logging operations.

II. Determination of Operating Expenses.
   A. Construction Work.
      1. Railroad.
         a. Main line.
         b. Spur lines.
         c. Switches.
      2. Woods roads and bridges.
      3. Camps.
      4. Skidways.
   B. Woods work.
      1. Cutting.
      2. Skidding.
      3. Brush disposal.
      4. Hauling.
      5. Feed and blacksmith.
      6. Road upkeep.
      7. Moving skidways.
   C. Railroading.
      1. Loading on cars.
      2. Hauling to mill.
      3. Unloading.
      4. Switching.
      5. Upkeep of equipment.
      6. Upkeep of right of way.
   D. Milling.
      1. Pond expense.
      2. Scaling.

3. Sawing.
4. Edging.
5. Planing.
6. Drying.

E. Yarding.
1. Sorting.
2. Transportation.
3. Piling.
4. Fire protection in yards and mill.
5. Loading on cars.

F. Overhead expenses.
1. Supervision.
2. Bookkeeping.
3. Legal and incidental expenses.
4. Selling.

G. Fixed charges.
1. Insurance and taxes.
2. Depreciation.
a. Of plant and buildings.
b. Of equipment.
c. Of railroad.
3. Interest on investment.
4. Obsolescence.
5. Wrecking value.

III. Determination of Stumpage Value.

A. Find selling price.
1. Count in value of by-products.

B. Find stumpage price by use of formula:

$$(S \div P) - O = X$$

in which S = selling price, $P = 1 +$ % of profit, O = the cost of operating, and X = the value of the stumpage.